The Acceptance of Instruments in Instrument mix Situations: Citizens' Perspective on Swiss Energy Transition

Karin Ingold[1, 2, 3], *Isabelle Stadelmann-Steffen*[2], *Lorenz Kammermann*[1, 2]

Corresponding author: *Karin Ingold, karin.ingold@ipw.unibe.ch;*
Institute of Political Science; University of Bern, Fabrikstrasse 8, CH-3012 Bern, Switzerland

Abstract

Citizens are the target group of sustainability policies, and their acceptance and subsequent behavioral change are key in transition processes. But what drives citizens to accept new instruments that will be added to a pre-existing instrument mix? To answer this question, we suggest an innovative combination of sustainability transitions and social acceptance research, and examine the case of Swiss energy turnaround. We rely on data from a representative sample of the Swiss resident population. By estimating logistic multi-response models, we disentangle individual and context-related factors that drive instrument preferences in a instrument mix situation. We conclude that it is mainly individual factors (values in favor of nuclear phasing out and climate mitigation) that positively impact the acceptance of instruments that promote the larger energy transitions through renewables. Additionally, the self-contribution of citizens (energy pro-sumers) seems to shape preferences more than current policies of their own jurisdiction.

Keywords: social acceptance, energy transition, instrument mix, citizens' perspective, political science

Highlights:

- Citizens are the target group of sustainability policies, and their acceptance and subsequent behavioral change are key in transition processes
- A combination of transitions studies and social acceptance allows for focus on citizens' policy preferences in an instrument mix situation

[1] Eawag, Swiss Federal Institute for Aquatic Sciences, ETH Domain, Switzerland
[2] University of Bern, Switzerland
[3] Oeschger Center for Climate Research, Bern, Switzerland

The Acceptance of Instruments in Instrument mix Situations: Citizens' Perspective on Swiss Energy Transition

1. Introduction

The aim of this paper is to contribute to a better understanding of policies and politics in the context of larger sustainability transitions in general (see Rogge & Reichardt 2016), and the energy turnaround in particular. More specifically, we focus on the processes of policy instrument selection, i.e., the introduction of public measures to reach pre-defined targets of larger socio-technical transitions (Markard et al. 2016a, 2012; Smith et al. 2005). Today, it is crucial to consider the whole instrument mix, and thus the interplay of different policy measures, as policy goals are rarely achieved by single state interventions only (see also Edmondson et al. 2018). In this context we argue that citizens' acceptance of policy instruments belonging to a wider instrument mix is a key driver to create necessary public understanding along with behavioral change and effective implementation. Research about energy policy in general, and renewable energy in particular, has repeatedly emphasized that a lack of social acceptance by communities or citizens is a crucial barrier to successful energy transition, as one example of fundamental sustainable transformation (Dermont et al. 2017; Wüstenhagen et al. 2007). However, most policy studies or research investigating socio-technical changes have focused largely on firms or the political elite (e.g., organizations and collective actors, see Markard et al. 2016a) when examining the role of actors in sustainable transitions (Fünfschilling & Truffer 2016; Geels 2002) and their reactions to state intervention (Markard et al. 2016a).

We agree that social acceptance is one key aspect to understanding policy change as one important element of a larger socio-technical transformation. However, we argue that the exclusive focus on the political elite, firms, or utilities neglects the important role citizens and individuals play with respect to a successful sustainable transition. In fact, citizens and local communities are typically exposed to policy decisions made at the national or next higher institutional level. Thus, they are often the direct addressees of policy instruments and are expected to change their behavior so as to achieve politically defined targets. Their reactions towards policy instruments (e.g., acceptance but also potential opposition) are crucial for the successful implementation of policy instruments, and for the success of larger sustainability transitions. This is not only the case in contexts with strong direct-democratic institutions where citizens are decision-makers, but also in purely representative political systems in which fundamental change—such as a transition from a conventional to a renewable energy system—

will not be feasible if the population does not support this change, at least to a certain degree (Steg et al. 2005). Such processes may take some time and evolve over time (Dreyer et al. 2015), and policies act as important triggers to raise public awareness about new technologies and also serve to induce behavioral change (e.g., citizens in their role as energy consumers or co-producers; see also Wolsink 2012). Most often, policies and policy instruments in particular, are introduced on top of a pre-existing portfolio of state measures (Martin 2016; Flanagan et al. 2011). As mentioned above, and to understand citizens' acceptance of policies promoting transition processes, we should not focus on single instruments, but rather on the configuration of policy instruments, i.e. instrument mix.

In summary, we combine the context of larger energy transition with insights from social acceptance research. Through this novel combination, we account for the importance of citizens as target actors for the realization of energy transitions and ask the following question: What are citizens' preferences towards new instruments promoting renewables in a instrument mix situation, and what factors influence these instrument mix preferences?

Our present study contributes to the literature in three respects. First, theoretically and conceptually, we try to fill the research gap in transitions studies by making use of insights about citizens' policy preferences from the social acceptance literature. More concretely, this not only provides the conceptual framework, but also provides theoretical mechanisms to analyze and better understand the role that citizens' play in the energy transition process. Second, existing research on the acceptance of policy instruments has either focused on citizens' acceptance of *single* instruments (Carattini et al. 2016; Thalmann 2004) or on several instruments within a mix at the *elite level* (Ingold 2011), and both perspectives have typically failed to account for trade-offs or interdependencies within this potential mix. Hence, by combining both citizens' perspective and instrument mix situations, we are able to gain new insights into how the political dimension drives or hinders changes in policies and instrument mixes and, ultimately, *socio-technical transitions* (Borras & Edler 2015). Third, empirically we propose an innovative approach to measure instrument mix preferences in the context of the Swiss energy turnaround. We thereby rely on novel survey data from Switzerland, where citizens had to indicate their preferences for various policy instruments promoting renewables to be introduced in their home canton (i.e., a sub-national entity). The estimations of multiresponse models enabled us to simultaneously analyze preferences for different policy instruments and, thus, to consider that preferences towards one specific policy instrument will also depend on what other instruments are available and preferred. Hence, this approach enabled us to conceptualize individual policy-mix preferences as a latent concept, which can

be measured by considering individual preferences towards different cantonal policy instruments.

The case of Switzerland seems most suitable to study citizens' policy-mix preferences. In federalist Switzerland, subnational legislation is subject to direct democracy, i.e., citizens' acceptance of political decisions is actively required by ballot or passively by not calling for a referendum. In this context, the need to study citizens' policy preferences is evident.

The present paper is structured as follows. First, we introduce insights from social acceptance literature and the relevance of focusing on citizens as subjects of acceptance. Then, we derive hypotheses on what drives the acceptance of certain policy instruments in energy transitions. Next, we describe our case under investigation, the methods and the data used, before presenting our empirical results in the subsequent section. We conclude with a summary of our crucial findings and a discussion about the potential advantages of analyzing the acceptance of various policy instruments simultaneously, rather than isolating single instruments.

2. Theory and concepts

Although cultural properties, self-organized initiatives, or private action significantly contribute to larger societal transformations or socio-technical changes (Borras & Edler 2015; Geels 2002), recent studies have convincingly demonstrated that policies in general, and policy instruments in particular, are important pieces of the puzzle in the complex picture of sustainability transitions (Markard et al. this issue; 2016a; Kivimaa & Kern 2016). The formation of socio-technical change might involve several policy changes and instruments at different points in time and in diverse policy sectors (see Markard et al. 2012; Smith et al. 2005). This also means that new policy instruments are rarely introduced in an isolated way: they are introduced in addition to a pre-existing portfolio of policy instruments (Flanagan et al. 2011; Holzinger et al. 2006). This can be the result of a strategic application of the "logics of combination or succession" (Ingold et al. 2016) where instruments are introduced jointly or subsequently to better reach defined targets. Or policy instruments co-exist because of a lack of such design strategies and there is a missed opportunity for "constructive destruction" (Kivimaa & Kern 2016), where instruments aiming at a different policy goal are dismissed in favor of instruments targeting new policy goals (see also Burke & Stephens 2017). In conclusion, the observable instrument mix is not a new construct, but rather a mix of old and new instruments.

This research is interested in how instruments are selected, integrated into or combined towards an instrument mix. We are thus in line with most recent studies investigating the impact of single instruments on other instrments in the same (Edmondson et al. 2018) and different areas (del Rìo & Cerdà 2017; Rosenow et al. 2017). Traditionally, research interested in policy decisions and instrument selection focuses on the political power-play among actors of the elite (Ingold 2011; Mills 1956), or on technocrats testing different alternatives in isolation from politics (Linder & Peters 1988). More recent studies integrate a wider array of actors involved in policy or socio-technical changes, such as utilities, firms, governmental actors, state officials, and the so-called stakeholders (Fünfschilling & Truffer 2016; Ingold 2011; Bressers & O'Toole 2005; Geels 2002; Mills 1956). Nevertheless, we argue that there is another important group that is still largely neglected in these studies: the citizens. As we will discuss, citizens also play a crucial role with respect to the effective introduction and implementation of policies and instruments. Thus, we below outline insights from social acceptance literature and thereby integrate a citizens' perspective into the transitions context. We thus define our dependent variable as the citizens' acceptance of policy instruments promoting energy transitions (2.2), and present hypotheses derived from the combination of transitions and acceptance studies (2.3).

2.1. Instrument acceptance at the citizens' level

Dermont et al., (2017) emphasize that the conceptualization of social acceptance always relates to a specific object of acceptance. In other words, the degree and drivers of acceptance depend on *what* citizens are supposed to accept. Hence, in the present study, this implies that citizens' instrument acceptance may be contingent on the instrument type and how different instrument types are combined (i.e., the instrument mix). Policy instruments include different types such as bans, prescriptions, taxes, subsidies, certificates, limits, standards, information campaigns, voluntary measures, etc. Most often, policy instruments are categorized in one of three instrument types (Vedung 1998): regulative, incentive, and persuasive measures. From the first to the last, the degree of coercion of the target group typically decreases (Sager 2009). But coercion is only one of several criteria or logics that an instrument comes with. For instance, and in a preliminary phase of state intervention, soft tools such as persuasive and voluntary measures can serve the purpose of sensitizing target groups and increasing the legitimacy of a new policy strategy (Sterner 2003). In contrast, regulative and more coercive instruments are prominently introduced in situations where strong state intervention and an immediate policy impact is desired (Ingold et al. 2016). Finally, incentive measures follow a

market logic and are supported by those who want price mechanisms to regulate target groups' behavior (Thalmann 2004).

Generally speaking, most citizens are targeted by a large variety of policy instruments, and to render them effective, they need to comply with these instruments, accommodate new rules, and change their behavior (Dermont et al. 2017; Batel et al. 2013, Steg et al. 2005). Policy design and implementation, mainly at the local level, can further rely on the direct support of citizens (for example, if the introduction of a new instrument is subject to a direct-democratic decision). In this vein, most prominently, Wüstenhagen et al. (2007) have argued that a lack of social acceptance (also by citizens) can serve as an important hurdle to the implementation of (renewable energy) policy. Thus, based on the social acceptance literature, we conclude that the question of what policy instruments citizens accept in a instrument mix context is crucial for the larger energy transition. Moreover, and against the background that citizens' acceptance and the conditions of acceptance heavily depend on what exactly needs to be accepted, a fine-grained perspective regarding different instrument types and the trade-offs between them needs to be considered.

A number of studies have examined citizens and their acceptance of renewable energy policies or, more generally, environmental-friendly issues. A first group has suggested that the design features of a policy — i.e., its specific elements and also perceptions of distributive fairness, risks and benefits — influence how citizens react to a policy (e.g., Schuitema et al. 2011; Loukopoulos et al. 2005; Poortinga et al. 2005; see also del Rìo & Cerdà 2017). Another group of studies adopts a socio-psychological perspective and, thus, focuses on individual characteristics (Batel & Devine-Wright 2015; Huijts et al. 2012). In particular, pro-environmental attitudes, environmental concerns, belief in human-induced climate change, or norms such as feeling an obligation to act in an environmentally-friendly manner have been identified as crucial triggers of policy acceptance (e.g., Shi et al. 2015; Lee et al. 2015; Karlstrøm & Ryghaug 2014; Loukopoulos et al 2005; Steg et al. 2005). A third and large group of studies has emphasized that the main problem is not citizens' acceptance at a general—i.e., socio-political—level, but rather that opposition tends to develop if these policies are materialized in specific contexts (e.g., Batel et al. 2013; Wüstenhagen et al. 2007; Bell et al. 2005; Devine-Wright 2005; Wolsink 2006; 2000). In the following section we discuss the three perspectives in more detail and derive our hypotheses. We thereby apply this research to the energy transition and instrument mix context.

2.2. Three drivers for citizens' instrument preferences in a instrument mix setting

Individual values and convictions

Previous research investigating the acceptance of (single) policy instruments has emphasized that actors' preferences for and acceptance of policy instruments are strongly contingent on the priority and salience they attribute to the problem, and also depend on their interests, beliefs, ideologies, and strategies (Borrás & Edquist 2013; Sabatier & Jenkins-Smith 1993). At the citizens level, a similar argument can be derived based on the social acceptance literature. Assuming a socio-psychological perspective, extensive research has been conducted on individual characteristics and the propensity to be supportive of renewable energy policies in general and specific instruments in particular (Batel & Devine-Wright 2015; Dermont 2018; Huijts et al. 2012; Kammermann and Dermont 2018; Stadelmann-Steffen and Dermont 2018). In particular, research in this field has shown that high environmental concerns, particularly the acknowledgement of a human-environment relationship, affect how individuals evaluate—and, thus, to what degree accept—renewable energy policies or environmental-friendly measures more generally (Kammermann and Dermont 2018; Lee et al. 2015; Shi et al. 2015; Loukopoulos et al. 2005; Steg et al. 2005).

These individual values and convictions may be particularly relevant with regard to far-reaching and more coercive (but possibly effective) instruments that induce stronger effects on citizens, i.e., costs or constraints. Various studies have shown that citizens may be reluctant to accept renewable energy policies in general because, from a personal or household perspective, these instruments tend to generate visible short-term costs, whereas the benefits, i.e., better environmental quality, is much more diffuse and only materializes in the future – if at all (Kirchgässner and Schneider 2003; Stadelmann-Steffen and Dermont 2018). Thus, Stadelmann-Steffen and Dermont (2018), focusing on incentive-based instruments, argue that citizens need some kind of compensation to accept these costs. They also show that ideological values may play an important role in this context. In other words, for individuals with strong environmental concerns and for those who acknowledge human-induced climate change, effective instruments may produce a "ideological benefit", which is able to to compensate for the costs of these instruments.

Based on these considerations, we argue that citizens in favor of a larger transition in a policy field have a greater tendency to accept new instruments in this field. We further hypothesize that for these transition advocates, renewable energy policies may have an "ideological benefit", and thus these individuals are more likely to also accept more coercive instruments compared to citizens who are not advocates of a larger transition.

> *H1a: Citizens tend to accept new instruments in a instrument mix situation when they are in favor of the larger transition in the political field.*
>
> *H1b: Citizens who are in favor of the larger transition in the political field are more likely to accept more coercive policy instruments and instrument mixes.*

Citizens' as pro-sumers

Policy formulation and implementation are highly intertwined processes. The role citizens may take on in policy implementation strongly impacts their position in formulating policy (Howlett & Lejano 2012). Similarly, the role they play in the established regime may impact their acceptance of solutions that still have niche characteristics. Thus, citizens may anticipate that they are being viewed as the future target group of a policy instrument, i.e., the addressees from whom a behavioral change is expected (Howlett et al. 2009). In general, target groups tend to prefer instruments that keep their costs low and their flexibility with respect to implementation as high as possible (Landry & Varone 2005).

However, depending on the policy instrument to be introduced, such a pessimistic view about a target group's preferences is not necessarily appropriate, as shown by social acceptance studies. Instruments like feed-in-tariff systems also can create opportunities and advantages for target groups. Recent technology development has enabled ordinary citizens to participate in the energy market as small decentralized producers of renewable electricity. For example, Wolsink (2013: 826) has argued: "By replacing the conventional consumer-producer relationship with multipronged relationships—the consumer co-producing and supplying for partners in the micro-grid as a distributed generator, and vice versa—entirely new relationships emerge." Thus, the present study focuses on such innovative new relationships because as soon as traditional policy addressees become co-producers of the (public) service, the relationship between the state and these actors changes. Public and private actors begin to engage in a partnership-like interaction in which private actors can gain some personal benefits (in terms of money, return on investment, or others). All of this may enhance their

instrument acceptance in general, and incentive-based mechanisms in particular. The latter are favored particularly because of their economic character, which particularly target producers.

> *H2a: Citizens tend to accept new instruments in a instrument mix situation when they assume the role of pro-sumers.*
>
> *H2a: Pro-sumers prefer incentive-based instruments and instrument mixes over persuasive and regulatory instruments.*

The existing policy context

Different instruments may impact each other differently, depending on whether they are introduced simultaneously or subsequently, or at the same or different levels (Ingold et al. 2016). When narrowing this premise to the level of citizens, preferences for new policy instruments may be contingent on what citizens already know from the context in which they live. On the one hand, generally, it can be assumed that citizens are more comfortable with accepting new instruments in a instrument mix situation if these new policies continue or strengthen the existing instrument mix. More precisely, citizens will be more likely to support new renewable energy (RE) instruments if they are embedded in a context (i.e., jurisdiction) that already exhibits a relatively comprehensive mix in this field (Rogge & Reichardt 2016; Sovacool 2009). This finding also is in accordance with previous research on the acceptance of RE policy, which has argued that public support "was always conditional to knowing, and understanding, the 'bigger picture'" (Ricci et al. 2008: 5877) of a new policy or technology. For example, Carattini et al. (2016) have argued that citizens' reluctance to support incentive-based ecological instruments is due to a lack of knowledge about how these instruments work. Similarily, it has been shown that prior (local) experience with a technology decreases opposition (Zoellner et al. 2008; Warren et al. 2005; Ek 2005). These described mechanisms are also in accordance with the observations that citizens tend to favor the well-known, i.e., the status quo, over new and seemingly insecure solutions (Mercer 2005; McDermott 2004; Kahneman & Tversky 1979). Hence, it can be expected that with respect to policy instruments and instrument mixes, citizens' experiences with renewable energy policies in their environment, i.e., their home canton, influence their readiness to accept new instruments in this area. Moreover, if a canton has already installed a rather comprehensive instrument mix, citizens will be more likely to support further coercive instruments.

> *H3a: Citizens tend to accept new instruments in a instrument mix situation when they live in a jurisdiction that already exhibits a comprehensive instrument mix.*

H3b: Citizens are more likely to accept more coercive instruments and instrument mixes if they live in a canton that already exhibits a comprehensive instrument mix

3. Research Design

3.1. Case description and instrument selection

After the Fukushima crisis in 2011, the Swiss government decided to begin a step-by-step phasing out of nuclear energy. This action requires that approximately 40% of Swiss electricity has to be replaced by alternative energy sources, or that energy savings and efficiency are required to help reduce consumption. One important pillar of the energy strategy 2050 (Swiss Confederation 2013), and thus the governmental program that concretizes the phasing out decision, is the promotion of RE sources in Switzerland. With respect to energy policy, the federalist structure attributes most competences to the subnational entities, the 26 cantons, which are involved in the design and implementation of national decisions. Currently, 26 different cantonal instrument mixes are being used to promote RE. In the framework of the energy strategy 2050, in which targets for renewables are more ambitious, new cantonal instruments and an increasing variety of approaches among the cantons may be emerging.

To account for this regional variance (for instance, see Hypothesis 3), we are interested in which instruments Swiss citizens prefer for the promotion of small-scale hydropower, wind, geothermal, and solar (PV) energy sources. We are not particularly interested in their preferences for one or several single instruments but, rather, want to examine what citizens accept in a instrument mix situation in which trade-offs and synergies among several instruments are possible. In line with the recent research evaluating policy designs and instruments (see for instance Schaffrin et al. 2015; Ingold 2011; Sager 2009), we focus on four different instruments that fulfill different characteristics or criteria (i.e., do not belong to the same instrument category; Vedung 1998), but also have a potential to be introduced in a combined way. These instruments include one persuasive instrument, two incentive instruments, and one regulative instrument, with their degree of coercion increasing from the first to the last: information and training for entrepreneurs, firms and citizens about how to construct and run RE projects; a tax relief and subsidies for the construction of renewable projects; and a ban on the construction of future non-renewable power plants. Although no canton has yet adopted the full portfolio of these four instruments, research on the more specific promotion of hydropower in the 26 Swiss cantons has shown that in a minority of cantons, a mix consisting of instruments belonging to the three mentioned categories can

already be observed (Kammermann 2017). This finding implies that such a mix is a realistic option and is not simply an artefact of our research.

3.2. Data, methods, and research design

Data

We collected the data set used in this contribution in Switzerland between March and May 2016. During this period, the first set of instruments to be used to implement the energy strategy 2050 were hotly debated in parliament. This conflict implied that in the context of our survey, the issue of RE promotion had received some media attention and had triggered a certain level of citizen discussion and involvement, although, from the citizens' perspective, the debate was not yet public but was occurring mainly at the elite level. The actual campaign to promote RE occurred one year later, which led to the introduction of a new energy law in a referendum vote in May 2017. Thus, in our survey, we measured general policy preferences in the context of the larger energy turnaround and related socio-technical change (as present in a non-campaign context), which may not translate directly into support for one or another instrument in a real-world vote context (see Dermont et al. 2017).

The trilingual survey[4] on future energy provision in Switzerland collected 8,287 answers from a representative sample of the Swiss permanent resident population (i.e., including non-citizens) provided by the Federal Office of Statistics, whereby respondents were invited by post to participate in an online survey.[5] After three invites, the response rate was 41.7%. Twenty-five percent of the total sample, or 1,985 individuals, received a question module on cantonal policy instruments. Due to missing values, we excluded 150 observations. The sample, on which the following analysis is based, consists of 1,835 individuals.

The demographic and structural composition of the sample used in the present study corresponds quite closely with the Swiss resident population (see Appendix), and is particularly true with respect to gender and education. Citizens older than 75 years are somewhat underrepresented, which is likely a result of the exclusive use of an online survey. In terms of political orientation, left-wing citizens are slightly overrepresented compared to the composition of Swiss voters according to the Swiss Election Study 2015 (Lutz 2016).

[4] The survey was conducted in German, French, and Italian, the three larger of the four national languages of Switzerland: 65.4% completed the survey in German, 26.0% in French, and 8.6% in Italian. Romansh individuals likely used the German version to answer the survey.

[5] The LINK Institute in Lucerne conducted the data collection process, and the Federal Office of Statistics provided the sample of postal addresses from the "Stichprobenrahmen für Personen- und Haushaltserhebungen" (SRPH).

In the context of the present study, our crucial question was: "Which instruments, laws, and rules do you think the canton should enact to promote the construction of new [small-scale hydropower/wind energy/geothermal/solar power] plants. Please mark all options you would support:[6]

- Stronger information, guidance, and education for persons who are interested in the construction of RE plants.
- Tax relief for operators of RE power plants.
- Subsidies for the construction of a new RE plant.
- A ban on the construction of non-renewable electricity plans."

It is important to note that in the context of the present study, we cannot measure acceptance or even support for the different policy instruments and instrument mixes (Dermont et al. 2017; Batel et al. 2013). In other words, we acknowledge that based on the (always hypothetical) survey context and given that at the time of the survey a direct-democratic campaign or intense public debate was not being carried out, we cannot derive direct conclusions about how citizens would decide on these issues in a ballot vote. Hence, our results should be conceived of as citizens' *preferences* (Dermont et al. 2017) that may feed into and thus influence the early stages of the policy-making process, i.e., when different alternatives are still on the political agenda and are being discussed.

Method

We coded each of the four items as a dummy variable: the value of 1 was assigned if a respondent supported the policy instrument, whereas a zero meant that this instrument (item) was not selected. The respondents were randomly assigned to the four different energy sources (small-scale hydropower, wind, geothermal, and solar energy). In the analyses, we controlled for the different energy sources by integrating fixed effects, i.e., dummies for three sources, and wind energy as a reference category.

Instead of estimating four different models in each one of the four dependent variables served as the dependent variable, we apply one multi-response model, i.e., a model with four dependent variables (Hadfield 2010). This approach enables us to analyze the individual support for the four instruments simultaneously. In statistical terms, the multi-response model

[6] Beside the four options used in the present analyses, four others were available (public tenders; cantons and municipalities should invest themselves in the production of renewable energy; energy firms should be commissioned to construct new plants; nothing, renewable energies should not be promoted).

accounts for a potential covariance between the four dependent variables and their covariates (Hadfield 2010; Subramanian et al. 2005). In other words, the multi-response model takes into consideration that an individual response regarding one policy item is not independent from a response to the other policy items. On the one hand, correlated behavior between the different policy instruments can be expected, since individuals are characterized by varying general propensities to support cantonal RE instruments, which influences the probability of their supporting any of the instruments. Moreover, as discussed theoretically, the different policy instruments reflect different degrees of coercion, which suggests that an individual who supports a ban and incentives will most probably also favor less coercive instruments, e.g., information campaigns. Hence, it is very likely that response behavior regarding policy instruments is correlated, which needs to be considered in the model (Subramanian et al. 2005). On the other hand, and more importantly in our case, since respondents need to reflect on the different policy options (i.e., which instruments, but also how many) they would support or reject, we can mimic a instrument mix situation. In other words, the observed preference pattern can be considered to be a instrument mix preference.[7] In addition, we account for the fact that respondents live in different cantons and thus different policy contexts. To account for this hierarchical structure, we estimate hierarchical models.

Finally, we apply a Bayesian estimation approach.[8] Bayesian models have been found to perform better than maximum likelihood, particularly in logistic models with a small number of level 2 units (Stegmüller 2013; Browne & Draper 2006). For an easy interpretation of the Bayesian estimation results, we present the mean and the standard deviation of the posterior distribution, which can be interpreted in a way similar to a standard regression situation—the mean is the average effect of an independent variable on the outcome variable. Moreover, we provide the 90% credible intervals, which are the Bayesian equivalent to confidence intervals

[7] It must be mentioned that respondents were not explicitly told that the questions were about instrument mixes, and they did not receive any explicit information on potential conflicts or interactions between some existing or new instruments. Although this approach might be a shortcoming of our measurement, the questions still ask respondents about what instruments and combinations of instruments they generally support (and which they do not). Moreover, providing respondents with a list of options encouraging them to think about how many instruments in total they would want to be realized (or to what extent RE should be promoted). Hence, by providing information on individual preferences for different instruments and on instrument combinations, as well as the number of supported instruments, our measurement approach captured two crucial aspects of instrument mix preferences.

[8] A fully Bayesian analysis requires the specification of priors for the unknown parameters. We used non-informative normal priors ~N(0, 10^8) for the fixed effect parameters, and inverse Wishart priors ~W1(2, 2) for the variance component. We estimated all models in R using the package MCMCglmm (Hadfield 2010). We let the respective models run for 500'000 iterations, with a respective burn-in of 400'000 and a thinning of 10. Diagnostics based on the graphical inspection of the trajectories and the autocorrelations, and Geweke diagnostics led to the conclusion that the chains have mixed well and converged.

in a standard regression context. If this interval does not include zero, a given 'effect' can be considered as systematic, i.e., 'significant.'

Operationalization

Our crucial independent variables with respect to the individual level are citizens' attitudes regarding nuclear phasing out and climate change (Hypotheses 1a and 1b), and whether a respondent is a pro-sumer of renewable electricity (Hypotheses 2a and 2b). The variable *nuclear phasing out* is a Likert scale (1 to 4) where high values indicate a preference for phasing out. The variable *climate change* consists of four items that capture whether an individual thinks that climate change is indeed happening and human made, or whether she/he questions the existence of climate change (Tabi & Wüstenhagen 2015). High values stand for the perception that climate change is a realistic issue, whereas low values indicate climate change skepticism. The standardized Cronbach's Alpha is 0.7, which implies that the internal consistency of the four variables is reasonably high. The acknowledgement of human-induced climate change and support for nuclear phasing out do not necessarily go together. In fact, an individual may believe in climate change but not support nuclear phasing-out, since nuclear energy may be perceived as a reasonable option (compared to fossil energy) for limiting climate change. Since we integrate the two variables separately in our analysis, our models can account for independent and even varying effects of the two constructs. Moreover, we define *pro-sumers* as those respondents who indicated that they produced renewable electricity or had a stake in RE production.

At the contextual level, our crucial explanatory variable is the current instrument mix (Hypotheses 3a and 3b). Thus, we coded cantonal policy instruments regarding small-scale hydropower, wind power, or solar energy (PV) (reference year 2015). Currently, these three technologies are the most promising RE technologies for the Swiss market (SFOE 2013). Other sources such as geothermal energy or biomass are still of marginal relevance, and regulators have given them little attention.[9] To assess policy comprehensiveness, we first identified all policy instruments used to promote these three technologies. Second, we assessed the instrument mixes according to density (number of instruments present) and intensity (e.g., the amount of resources used, strictness of standards, etc.) (Knill & Tosun 2012; see also, e.g., Kammermann 2017 or Metz 2017). Cantons with little to no instruments promoting these three

[9] Prominently missing among these other sources is large-scale hydropower (mega-dams), which currently is about 60 percent of Swiss electricity production. Our study does not focus on this technology because it is already a well-established/dominant system and does not need to be newly established in the market as do other alternative technologies.

sources receive a value of 0. Cantons that employ a broad variety of instruments—from information to subsidies and regulatory standards—and that coordinate their efforts with other policy fields such as environmental protection or construction receive the maximum value of 1. We calibrated values between 0 and 1 with .25 increments. Based on these evaluations, we also created a dummy variable with a value of 1 if a canton comprehensively promoted (>= 0.5) at least one source. This approach accounted for the fact that most cantons—depending on physical conditions and other factors—promote one energy source, but not all together. For example, a canton may have a high potential for small-scale hydropower, but not for wind or solar energy. Hence, this canton will concentrate on promoting small-scale hydropower, but will probably refrain from making a significant investment in other energy sources.

In the context of Hypotheses 3 testing, we also wish to outline some thoughts about timing and our research perspective. Hypothesis 3 expresses our expectation that instruments that were introduced in the past have an impact on current instrument preferences. More generally speaking, we acknowledge that policies might be one important means of raising awareness and inducing behavioral change towards transitions. Thus, conceptually, this implies that our analysis involves procedural aspects and elements with dynamic characteristics. Unfortunately, however, we are not able to explicitly grasp these dynamics based on our cross-sectional and, thus, static data. However, by measuring the cantonal instrument mix one year before the citizens' survey took place, we are able to establish – at least conceptually – causality, i.e., citizens responses are supposed to be influenced by what has been done before and thus, what exists in the respective canton.

Finally, we account for further individual characteristics that are expected to affect individual preferences for RE policy in general, and instrument mix in particular. These variables are: gender (ref. cat.: female), age (ref. cat.: 18—30 years old), education (ref. cat.: medium education), whether an individual has children or not, and political ideology (ref.cat.: no political ideology).

Additional information on the variables, their operationalization, and descriptive statistics can be found in the Appendix.

4. Analysis and Results

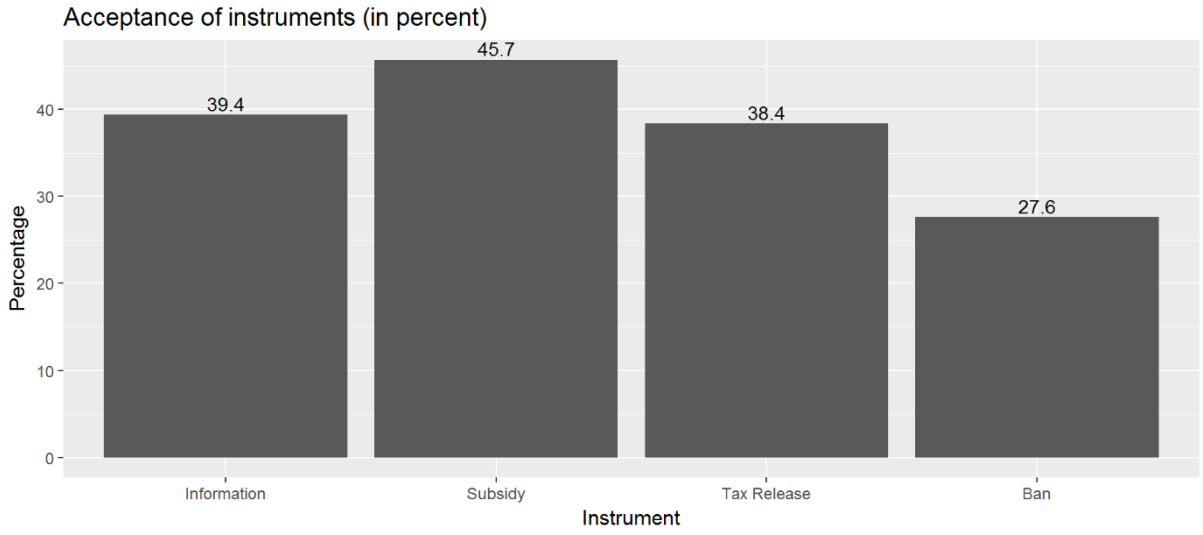
In this section, we present our empirical results. Figure 1 provides an overview of the acceptance rates of the four instruments. The graph shows that subsidies are most popular, with 45.6% of the respondents supporting this instrument at the cantonal level. Information

and tax reliefs exhibit a somewhat lower acceptance rate of 38.5% and 37.6%, respectively, whereas bans are only supported by roughly a quarter of the respondents. Although none of the instruments receive a majority support, a clear majority favors some kind of policy intervention (i.e., supports at least one of the four instruments; see also Table 2).

Moreover, Table 1 demonstrates that individual responses regarding the acceptance of the four instruments are, for the most part, significantly correlated, although not very strongly. This finding lends support to the validity of our conceptualization of instrument mix preferences. On the one hand, the significant correlations confirm that individual responses regarding the different policy instruments are not independent from each other. Methodologically, this means that multiresponse models that account for this dependence are the right choice. Substantially, the positive correlation indicates that citizens who support one instrument are also more likely to support another, i.e., a certain propensity exists for instrument (not) support. On the other hand however, the rather small correlation coefficients also reveal that citizens do not support or reject all instruments automatically, but rather, they differentiate between instruments and specifically choose one but not necessarily others. Hence, citizens have varying preferences for how instruments are combined (including the possibility of rejecting any instrument promoting RE)—in other words, citizens prefer different instrument mixes. More substantially, whereas citizens who support information also tend to accept the three other instruments, market-oriented policies (subsidies and tax reliefs) are not correlated significantly with bans. These descriptive results may reflect the fact that the instrument 'information' is mainly supported by citizens to (in a soft way) promote RE. Conversely, market-based instruments that are targeted at firms also can be supported by citizens for economic rather than environmental reasons, which leads to higher overall acceptance rates.[10] Furthermore, a ban on energy production from non-RE sources is the most coercive instrument, which only a minority of citizens is ready to support.

[10] Unfortunately, we are not able to empirically distinguish between the varying motivations for preferences of a specific instrument.

Figure 1: Acceptance rates of policy instruments.



Note: Share of respondents (in %) indicating that the canton should use the respective instrument to promote RE. N = 1835.

Table 1: Correlations between policy instruments

	Information	Subsidy	Tax relief	Ban
Information	1			
Subsidy	0.17	1		
Tax relief	0.13	0.28	1	
Ban	0.12	0.02	0.00	1

Note: Pearson's correlations (Phi coefficients) between individual responses per instrument. Grey = p-value is below 0.05 (significant at the 95% level). N = 1835.

Table 2: Frequency of preferred instrument mixes

	Number of respondents	%
None	400	21,8%
subsidy and tax relief	169	9,2%
only subsidy	165	9,0%
All but ban	156	8,5%
only information	135	7,4%
Only ban	118	6,4%
Information and subsidy	120	6,5%
only tax relief	119	6,5%
All	77	4,2%
Information and ban	74	4,0%

Information and tax relief	65	3,5%
Subsidy and ban	60	3,3%
All but tax relief	58	3,2%
All but information	51	2,8%
All but subsidy	37	2,0%
Tax relief and ban	31	1,7%
Total	***1835***	***100%***

Note: Frequencies of individual instrument mixes.

Hence, by supporting one but not other instruments, citizens indicate their 'personal' instrument mix preference for their canton. This conclusion is further supported by the results in Table 2, which depict varying response patterns and their frequencies. These results provide further evidence about the instrument mix citizens prefer: 23.5% of the respondents do not support any instrument to promote RE, whereas 28.7% prefer the promotion of only one of the four instruments. In contrast, roughly half of the surveyed citizens prefer a mix. A general observable trend exists that comprehensive and coercive mixes are the least preferred categories, whereas a market-oriented promotion, mostly in combination with soft tools (information), is the most widely accepted mix.

Subsequently, to test our hypotheses, based on the multi-response regression models, we more systematically investigate to what extent individual and cantonal characteristics can explain these preferences with respect to cantonal policy instruments.

Figure 2 presents our basic model in which the four instruments (items) regarding cantonal (i.e., sub-national) promotion of renewables serve as dependent variables. A first and important observation, also in line with the descriptive findings above, is that the results are not identical across the four different policy instruments.[11] For example, citizens with a rightist political ideology—compared to citizens who do not locate themselves politically—more strongly prefer incentive-based instruments, whereas this pattern does not occur in relation to information and a ban on non-RE. Similarly, respondents with children more often opt for tax reliefs and subsidies, while exhibiting lower preferences for information than their childless counterparts. Finally, although education is not related systematically to preferences for tax reliefs, information, and a ban, highly educated citizens tend to opt for subsidies more

[11] However, further models that included the response variables to predict the three other responses (i.e., path models) revealed that the four responses significantly correlate with each other (the only exception is that preferences for tax reliefs are not related systematically to preferences for a ban). This finding can be interpreted to mean that the different policy preferences can indeed be interpreted to measure an (latent) individual instrument mix preference.

frequently than respondents with lower education. These results once more imply that our dependent variables not only capture a general propensity to support cantonal RE instruments, but also that citizens can and do distinguish between different instruments. In other words, citizens do select different instrument mixes when asked about what cantonal policy instruments should be implemented.

When moving to our crucial explanatory variables at the individual level, we observe that attitudes towards nuclear phasing out are related to individual instrument mix preferences (with the exception of tax reliefs, the coefficients are systematically different from zero). Most importantly, citizens who support nuclear phasing out exhibit a strong preference for regulatory instruments, i.e., a ban on non-renewable electricity production. This strong relationship may reflect that the ban on nuclear power plants is one of the most prominent examples for this policy instrument. However, these citizens also more frequently and systematically support information and subsidies, whereas preferences for nuclear phasing out are unrelated to support for tax reliefs. With respect to climate change skepticism, the same pattern can be observed, although the strength of the estimated effects is roughly equally strong for information, subsidies, and bans. Hence, from these results we conclude that—as proposed in Hypotheses 1a and 1b—citizens who are in favor of a larger transition in the political field, i.e., who believe in human-induced climate change and/or support nuclear phasing out, generally have a higher propensity to support cantonal RE policies (confirmation of Hypothesis 1a) and display a tendency to prefer more coercive over less coercive policy instruments (confirmation of Hypothesis 1b). Most importantly, these citizens opt for a instrument mix that bans non-RE production and also includes information and subsidies.

Hypothesis 2 focuses on the so-called *pro-sumers*, i.e., citizens who are not only consumers of electricity, but moreover contribute to the production of RE either as producers (e.g., who have solar collectors on their roofs) or investors. Interestingly, even though these citizens have a stake in RE policy, they generally do not support new cantonal policy instruments more strongly than other citizens (rejection of Hypothesis 2a). However, and as hypothesized, pro-sumers are characterized by a systematically stronger preference for both subsidies and tax reliefs (in accordance with Hypothesis 2b). This finding can be interpreted as private individual producers showing solidarity for large-scale producers, i.e., they support instrument mixes that focus on economic incentives for RE production.

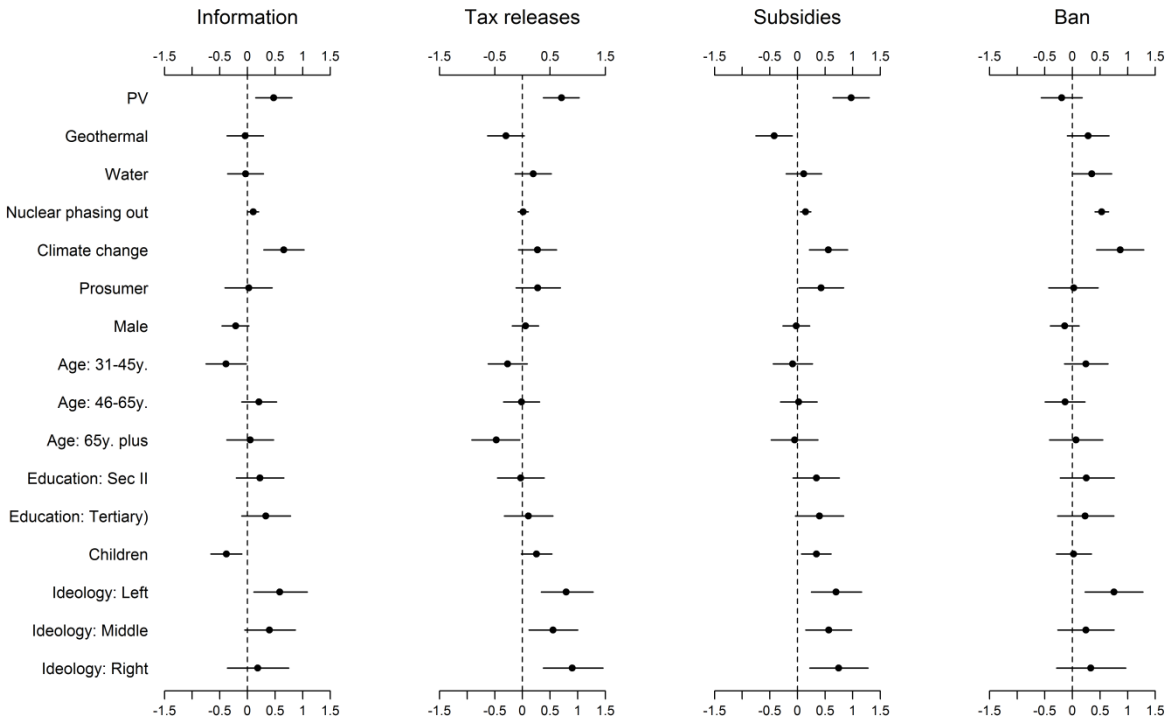
In a next step, we analyze whether the existing cantonal instrument mix for the field of RE policy affects citizens' preferences regarding new cantonal instruments (Hypotheses 3a and 3b). These models demonstrate that a systematic relationship does not exist between the

cantonal policy context and individual instrument mix preferences. None of our four instrument mix variables (i.e., an overall cantonal energy strategy containing RE policy instruments, and the specific promotional cantonal policy with respect to small-scale hydropower, wind, and PV; see section 3.2 for more detailed information about the four variables) is related systematically to the level of support for the four policy instruments (see Figure 3 for the example of the cantonal energy strategy). Moreover, the deviance information criterion (DIC) indicates that the more parsimonious model—i.e., without the cantonal context—is the preferred model.

As mentioned previously, we randomly assigned the respondents to four different energy sources. In other words, their responses reflect their preferences regarding instrument mix with regard to small-scale hydropower, wind, geothermal, or solar energy, respectively. Thus, we also estimate further models in which we interact the cantonal policy variables with the energy sources. By so doing, we are able to test whether, for example, an extensive cantonal instrument mix in the area of small-scale hydropower affects individual preferences regarding policies in this area. However, these additional analyses do not reveal any systematic relationship between cantonal policy variables and individual instrument mix preferences.

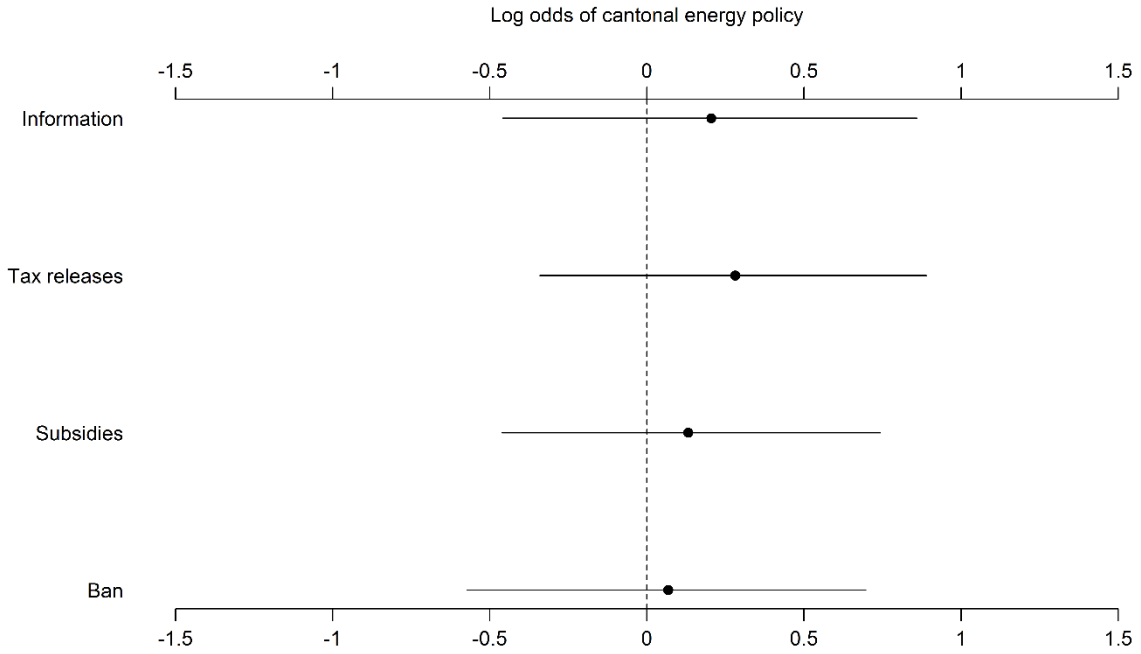
Although our data does not support Hypothesis 3, this finding does not necessarily mean that the cantonal context, i.e., the status quo, is unrelated to individual preferences regarding cantonal instrument mixes. We conclude, however, that the institutional indicators we used to capture cantonal energy policy might be too abstract to influence individual preferences. On the one hand, most citizens' may just not know what policy their home canton has put in place. On the other hand, institutional indicators are not visible to citizens in their daily life. Both aspects make a close association unlikely between these cantonal instrument mix variables and individual instrument mix preferences.

Figure 2: Individual instrument mix preferences.



Note: Hierarchical, logistic multi-response, Bayesian estimation using MCMCglmm in R. The mean and the 95% credible interval of the log odds are presented. For illustrative purposes, we multiplied the coefficient of the variable *climate change* by 10. N = 1835. DIC = 9150. 8.

Figure 3: Cantonal policy context and instrument mix preferences.



Note: Log odds and 95% credible interval of the cantonal energy policy on preferences for the four instruments. Model as presented in Figure 2 additionally includes the cantonal energy policy. The other variables are not shown for illustrative purposes but are highly consistent to Figure 2. N = 1835. DIC = 9153.2

5. Discussion and Conclusion

In this study, we investigated the factors that drive citizens' acceptance of new policy instruments, which are to be added to a pre-existing instrument mix in the case of an ongoing transition in the energy sector. We argue that citizens' acceptance is one relevant criterion with respect to examining policy instruments, since citizens may become the target group of a large variety of policy instruments introduced by different jurisdictions at different levels. In a narrow sense, their acceptance is crucial for instrument support at the ballot, and their later implementation. More broadly speaking, citizens' acceptance may lead to important policy change, which subsequently contributes to larger socio-technical change.

We focused on energy policy and the energy transition in Switzerland. For our analyses, we relied on data gathered through a citizens' survey, which asked respondents about their preferences for four instruments (information, tax relief, subsidies, or bans) to support small-scale hydropower, wind, and solar energy. One main contribution of this approach is that we did not focus on policy instruments separately, but presented them in a instrument mix situation and in relation to the pre-existing instrument mix. The first aspect accounts for the fact that policy instruments do not exist and are not introduced in isolation, but rather along with other instruments, i.e., a instrument mix. For individual preferences this means that the resulting interactions and potential trade-offs need to be considered. The second aspect (i.e, relating preferences back to the existing mix), emphasizes a dynamic perspective of energy transitions: it is not only about the cause-effect relationship between instruments and how they attempt to realize predefined sustainability targets, but also about the policy process and dynamics related to how instruments are accepted and are later selected in relation to a pre-existing mix. This aspect has implications for how the energy transition may evolve and be achieved. Based on our cross-sectional data, we were only partly able to capture these procedural aspects empirically, thus, future research should investigate these dynamic elements more specifically, ideally adopting longitudinal data gathering and treatment.

Our analyses initially revealed that, among citizens, subsidies are the most preferred instrument, followed by information, taxes, and bans. Moreover, and importantly, citizens do

not express preferences in favor of one, and against other instruments. This is therefore an indicator that citizens acknowledge that only a instrument mix, i.e., a combination of instruments, might address the issue of future energy policy.

Our results further imply that there is no consistent association between the level of coerciveness of instruments and public support. Although, overall, bans are the least accepted instruments in the instrument mix (Table 1), the degree of state intervention and coerciveness with respect to the target group is not the only or most relevant criterion influencing citizens to reject (as opposed to accept) an instrument, rather, individual factors, in particular, produce more nuanced preference patterns.

In this vein, information is most likely to be accepted by those citizens favoring nuclear phasing out, and those voting for center or left parties. Tax reliefs are preferred by citizens with children, and by those with a clear partisan ideology (being left or right). The same is true for subsidies, but this instrument is also particularly preferred by advocates of nuclear phasing out and effective climate change policy. The two latter groups, and also supporters of left parties, are most likely to opt for bans, the most coercive instrument in the mix.

We are thus able to empirically corroborate Hypothesis 1, suggesting that individual values and convictions (support for nuclear phasing out and climate change mitigation) influence preferences for policy instruments in a policy-mix situation and, particularly, support for more coercive instruments. This is an interesting result because it speeks to the literature finding evidence that deeper values and convictions impact policy preferences and political behavior (Jenkins-Smith et al. 2014). Thus, if policy change is crucial for larger socio-technical change, and if both strongly depend upon values, convictions and world-views, the question arises of how to impact or alter these values and the underlying ideologies. In this context, different perspectives exist: while some authors acknowledge that actors included in policy processes might be able to learn over time (Sabatier 1986), others argue that an external shock is needed in order to induce ideological, policy, and ultimately more radical, change (Birkland 1998). The process under study in this paper was definitely impacted by the Fukushima crises, which can be interpreted as a focusing event and external shock. We thus conclude that using windows of opportunity that open after shocks or focusing events, as well as providing citizens with adequate information, seems crucial for shaping citizens' preferences.

We also found empirical support for Hypothesis 2, which states that pro-sumers are more strongly in favor of market-based instruments than bans. Thus, citizens who perceive themselves as potential investors and co-producers of alternative energies have a greater

tendency to accept tax reliefs and subsidies over other instruments, and support them more strongly than other citizens who are not potential investors or co-producers.

Hypothesis 3 assumed that citizens living in a jurisdiction with an already comprehensive instrument mix tend to accept new instruments more strongly than others who do not live in a similar jurisdiction. We did not find clear results for this assumption. The comprehensiveness of an already introduced instrument mix in a region or jurisdiction is not, in a general and systematic way, related to individual preferences. However, we have used an institutional indicator to capture these cantonal policy contexts, which may not be very visible for citizens. Therefore, further research should more thoroughly reflect on how to measure an existing instrument mix in a way that can capture actual individual perceptions of and experiences with a jurisdiction's energy policy.

Our study has shown that personal characteristics and attitudes play an important role in influencing individual instrument mix preferences. To push towards an energy transition, policy makers are well-advised to enable citizens' participation and to hear their concerns, but also to sensitize citizens about the "bigger picture" and thus increase the legitimacy of the energy transition. The latter seems to be an important precondition for citizens to accept instruments that are stronger and more coercive. Our research design has also revealed the relevance of including the citizens' perspective when studying larger transition processes. However, more research is needed to disentangle the relative contribution of citizens to policy change, compared to firms, scientific institutions, or the political elite. A combination of sophisticated survey methods and data analysis, as presented here, with in-depth case knowledge, qualitative and longitudinal data assessment seems to be a fruitful path for future research.

6. References

Batel, S., and P. Devine-Wright (2015). Towards a better understanding of people's responses to renewable energy technologies: Insights from Social Representations Theory. Public Understanding of Science 24(3): 311-25.

Batel, S., P. Devine-Wright, and T. Tangeland (2013). Social acceptance of low carbon energy and associated infrastructures: A critical discussion. Energy Policy 58(1): 1-5.

Bell, D., T. Gray, and C. Haggett (2005). The 'Social Gap' in Wind Farm Siting Decisions: Explanations and Policy Responses. Environmental Politics 14(4) : 460-477.

Birkland, T.A. (1998). Focusing Events, Mobilization, and Agenda Setting. Journal of Public Policy 18: 53 – 74.

Borrás, S., and J. Edler (2015). The governance of change in socio-technical and innovation systems: three pillars for a conceptual framework. In S. Borrás & J. Edler (Eds.), Eu-SPRI Forum on Science, Technology and Innovation Policy series. The Governance of Socio-Technical Systems. Explaining Change (pp. 23–48). Cheltenham: Edward Elgar Publishing.

Bressers, H., and L. O'Toole (2005). Instrument selection and implementation in a networked context. In Designing Government: From Instruments to Governance by Pearl Eliadis et al. McGill Queen's University Press.

Browne, W. J., and D. Draper (2006). A comparison of Bayesian and likelihood-based methods for fitting multilevel models. Bayesian Analysis 1(3): 473-514.

Burke, M.J., J.C. Stephens (2017). Energy democracy: Goals and policy instruments for sociotechnical transitions. Energy Research & Social Science 33 (2017) 35–48.

Carattini, S., A. Baranzini, P. Thalmann, F. Varone, and F. Vöhringer (2016). Green taxes in a post-Paris world: are millions of nays inevitable? Centre for Climate Change Economics and Policy, Working Paper No. 273, Grantham Research Institute on Climate Change and the Environment Working Paper No. 243.

Dermont, C. (2018). Environmental Decision-Making. The Influence of Policy Information. Environmental Politics 21(4). Online first.

Dermont, C., K. Ingold, L. Kammermann, and I. Stadelmann-Steffen (2017). Bringing the policy making perspective in: A political science approach to social acceptance. Energy Policy 108: 359–368. https://doi.org/10.1016/j.enpol.2017.05.062.

Devine-Wright, P. (2005). Local aspects of UK renewable energy development: exploring public beliefs and policy implications. Local Environment 10(1): 57-69.

Dreyer S.J., I. Walker, and M.F. Teisl (2015). Australians' views on carbon pricing before and after the 2013 federal election. Nature Climate Change 5: 1064–1067. doi:10.1038/nclimate2756

Edmondson, D.L., F. Kern, K. Rogge (2017). The co-evolution of policy mixes and socio-technical systems: Towards a conceptual framework of policy mix feedback in sustainability transitions. Research Policy. https://doi.org/10.1016/j.respol.2018.03.010

Ek, K. (2005). Public and private attitudes towards ''green'' electricity: the case of Swedish wind power. Energy Policy 33: 1677–1689

Flanagan, K., E. Uyarra and M. Laranja (2011). Reconceptualising the 'instrument mix' for innovation. *Research Policy* 40(5): 702-713.

Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. Research Policy 31(8-9): 1257–1274. doi:10.1016/S0048-7333(02)00062-8

Hadfield, J. D. (2010). MCMC methods for multi-response generalized linear mixed models: the MCMCglmm R package. Journal of Statistical Software 33 (2): 1-22.

Holzinger, K., D. Knill, and A. Schäfer (2006). Rhetoric or Reality? 'New Governance' in EU Environmental Policy. European Law 12(3): 403-420.

Howlett, M., M. Ramesh, and A. Perl (2009). Studying Public Policy: Policy Cycles and Policy Subsystems (3rd edition). Oxford: Oxford University Press.

Howlett, M., and R. Lejano (2012). Tales from the Crypt: The Rise and Fall (and Rebirth?) of Policy Design. Administration & Society 20(10): 1-25.

Huijts, N.M.A., E.J.E Molin, and L. Steg (2012). Psychological factors influencing sustainable energy technology acceptance: A review-based comprehensive framework. Renew Sust Energ Rev 16(1) : 525-531.

Ingold, K. (2008). Les mécanismes de décision: Le cas de la politique climatique Suisse. Politikanalysen. Zürich: Rüegger Verlag.

Ingold, K. (2011). Network Structures within Policy Processes: Coalitions, Power, and Brokerage in Swiss Climate Policy. Policy Studies Journal 39(3): 435-459.

Ingold, K., E. Lieberherr, I. Schläpfer, K. Steinmann, and W. Zimmermann (2016). Umweltpolitik der Schweiz – ein Lehrbuch. Zürich/St. Gallen: Dike Verlag.

Jenkins-Smith, H.C., C.L. Silva, K. Gupta, and J. T. Ripberger (2014). Belief system continuity and change in policy advocacy coalitions: Using cultural theory to specify belief systems, coalitions, and sources of change. Policy Studies Journal 42(4): 484-508.

Kahneman, D. and A. Tversky (1979). Prospect theory: an analysis of decision under risk, Econometrica 47: 263-291.

Karlstrøm, H., and M. Ryghaug (2014). Public attitudes towards renewable energy technologies in Norway. The role of party preferences. Energy Policy 67(issue C): 656-663.

Kammermann, L. (2017). Factors Driving the Promotion of Hydroelectricity: A Qualitative Comparative Analysis. Review of Policy Research, online first. https://doi.org/10.1111/ropr.12274

Kammermann, L., & Dermont, C. (2018). How beliefs of the political elite and citizens on climate change influence support for Swiss energy transition policy. Energy Research & Social Science, (May), 1–13. https://doi.org/10.1016/j.erss.2018.05.010

Kirchgässner, G., & Schneider, F. (2003). On the Political Economy of Environmental Policy. Public Choice, 115(3/4), 369–396. https://doi.org/10.1023/A:1024289627887

Kivimaa, P., and F. Kern (2016). Creative destruction or mere niche support?: Innovation instrument mixes for sustainability transitions. Research Policy 45(1): 205–217. doi:10.1016/j.respol.2015.09.008

Knill, Ch., and J. Tosun (2012). Public Policy – A New Introduction. Chippenham/Eastbourne: Palgrave Macmillan.

Landry, R., and F. Varone (2005). Choice of policy instruments: confronting the deductive and the interactive approaches. In Designing Government: From Instruments to Governance by P. Eliadis et al. (Eds.), McGill Queens University Press.

Lee, T. M., E.M. Markowitz, P.D. Howe, C.-Y. Ko, and A.A. Leiserowitz (2015). Predictors of public climate change awareness and risk perception around the world. Nature Climate Change 5(11): 1014–1020.

Linder, S, and G. Peters (1988). The Analysis of Design or the Design of Analysis. Review of Policy Research 7(4): 738-750.

Loukopoulos, P., C. Jakobsson, T. Gärling, C. Schneider, and S. Fujii (2005): Public attitudes towards policy measures for reducing private car use. Evidence from a study in Sweden. In: Environmental Science & Policy 8 (1): 57-66. DOI: 10.1016/j.envsci.2004.07.008

Lutz, G. (2016). Eidgenössische Wahlen 2015. Wahlteilnahme und Wahlentscheid. Lausanne: Selects – FORS.

Markard, J., R. Raven, B. Truffer (2012). Sustainability Transitions: An emerging field of research and its prospects. Research Policy 41: 955-967.

Markard, J., S. Wirth, and B. Truffer (2016b). Institutional dynamics and technology legitimacy – A frame work and a case study on biogas technology. Research Policy 45: 330-344.

Markard, J., M. Suter, and K. Ingold (2016a). Socio-technical transitions and policy change – Advocacy coalitions in Swiss energy policy. Environmental Innovation and Societal Transitions 18(1): 215–237. doi:10.1016/j.eist.2015.05.003

Markard, J., M. Lindberg, and A. Dahl Andersen (This issue). EU policy instrument mix and policy preferences in the case of the energy transition. Research Policy.

Martin, B. (2016). R&D Policy Instruments – A Critical Review of What We Do and Don't Know. Industry and Innovation 23(2): 157-176.

McDermott, R. (2004). Prospect Theory in Political Science: Gains and Losses from the First Decade. Political Psychology 25(2): 289-312.

Mercer, J. 2005. Prospect Theory and Political Science, Annual Review of Political Science 8: 1-21.

Metz, F. (2017). From Network Structure to Policy Design in Water Protection: A Comparative Perspective on Micropollutants in the Rhine River Riparian Countries. Springer Verlag.

Mills, C. W. (1956). The Power Elite. Qxford University Press.

Poortinga, W., L. Steg, Ch. Vlek, and G. Wiersma (2003). Household preferences for energy-saving measures: A conjoint analysis. Journal of Economic Psychology 24 (1): 49-64. DOI: 10.1016/S0167-4870(02)00154-X

Ricci, M., P. Bellaby, and R. Flynn (2008). What do we know about public perceptions and acceptance of hydrogen? A critical review and new case study evidence. International journal of hydrogen energy 33(1): 5868 – 5880.

Del Rìo, P., E. Cerdà (2017). The missing link: The influence of instruments and design features on the interactions between climate and renewable electricity policies. Energy Research & Social Science 33 (2017) 49–58.

Rogge, K. S., and K. Reichardt (2016). Instrument mixes for sustainability transitions: An extended concept and framework for analysis. Research Policy 45(1): 1620-1635.

Rosenow, J., F. Kern, K. Rogge (2017). The need for comprehensive and well targeted instrument mixes to stimulate energy transitions: The case of energy efficiency policy. Energy Research & Social Science 33 (2017) 95–104

Sabatier, P. A. (1986). Top - down and Bottom - up Approaches to Implementation Research: A Critical Analysis and Suggested Synthesis. Journal of Public Policy 6: 21–48.

Sabatier, P. A., and H. Jenkins-Smith (1993). Policy Change and Learning: An Advocacy Coalition Approach. Boulder, CO: Westview Press.

Sager, F. (2009). Governance and Coercion. Political Studies 57(3): 537-558.

Schaffrin, A., S. Sewerin, and S. Seubert (2015). Toward a Comparative Measure of Climate Policy Output. The Policy Studies Journal 43(2): 257-282.

Schuitema, G., L. Steg, and M. van Gruining (2011) When Are Transport Pricing Policies Fair and Acceptable? Social Justice Research 24 (1): 66-84.

Smith, A., A. Stirling, and F. Berkhout (2005). The governance of sustainable sociotechnical transitions. Research Policy 34: 1491–1510.

Schweizer-Ries, P., I. Rau, and J. Zoellner (2010). Aktivität und Teilhabe – Akzeptanz erneuerbarer Energien durch Beteiligung steigern. Otto-von-Guericke-Universität Magdeburg.

Shi, J., V. Visschers, and M. Siegrist (2015). Public Perception of Climate Change: The Importance of Knowledge and Cultural Worldviews. Risk analysis : an official publication of the Society for Risk Analysis 35(12): 2183–2201.

Sovacool, B. K. (2009). The importance of comprehensiveness in renewable electricity and energy-efficiency policy. Energy Policy 37(4): 1529–1541. doi:10.1016/j.enpol.2008.12.016

Stadelmann-Steffen, I., & Dermont, C. (2018). The unpopularity of incentive-based instruments: what improves the cost–benefit ratio? Public Choice, 175(1–2), 37–62. https://doi.org/10.1007/s11127-018-0513-9

Steg, L., L. Dreijerink, and W. Abrahamse (2005). Factors influencing the acceptability of energy policies. A test of VBN theory. Journal of Environmental Psychology 25 (4): 415-425.

Stegmüller, D. (2013). How Many Countries for Multilevel Modelling? A Comparison of Frequentist and Bayesian Approaches. American Journal of Political Science 57(3): 748-761.

Sterner, T. (2003). Policy Instruments for Environmental and Natural Resource Management. Washington, DC: Resources for the Future.

Subramanian, S. V., D. Kim, and I. Kawachi (2005). Covariation in the socioeconomic determinants of self rated health and happiness: a multivariate multilevel analysis of individuals and communities in the USA. Journal of Epidemiology and Community Health 59: 664-69.

Swiss Confederation (2013). Botschaft zum ersten Massnahmenpaket der Energiestrategie 2050 (Revision des Energierechts) und zur Volksinitiative „Für den geordneten Ausstieg aus der Atomenergie (Atomausstiegsinitiative)“ vom 4. September 2013. Bern.

Swiss Federal Office of Energy SFOE (2013). Energieperspektiven 2050. Zusammenfassung. Bern.

Tabi, A., and R. Wüstenhagen (2015). Befragung der Anwohner von möglichen Windparks in der Ostschweiz. Institut für Wirtschaft und Ökologie. Universität St. Gallen. http://bit.ly/1P7AT4m (accessed 12.02.2015).

Thalmann, P. (2004). The public acceptance of green taxes and million voters express and their opinion. Public Choice 119: 179-217.

Vedung, E. (1998). Policy Instruments: Typologies and Theories. In Carrots, Sticks and Sermons: Policy Instruments and their Evaluation by Marie-Louise Bemelmans-Videc, Ray C. Rist and Evert Vedung (Eds.). New Brunswick and London: Transaction Publishers.

Warren, C. R., C. Lumsden, S. O'Dowd, and R. V. Birnie (2005). Green On Green': Public Perceptions of Wind Power in Scotland and Ireland. Journal of Environmental Planning and Management 48(6): 853 – 875..

Wolskink, M. (2000). Wind power and the NIMBY-myth: institutional capacity and the limited significance of public support. Renewable Energy 21: 49-64.

Wolsink, M. (2006). Invalid theory impedes our understanding: a critique on the persistence of the language of NIMBY. Transactions of the Institute of British Geographers 31: 85–91.

Wolsink, M. (2012). The research agenda on social acceptance of distributed generation in smart grids: Renewable as common pool resources. Renewable and Sustainable Energy Reviews 16(1): 822-835.

Wolsink, M. (2013). The next phase in social acceptance of renewable innovation. EDI Quarterly 5(1): 10-13.

Wüstenhagen, R., M. Wolsink, and M. J. Bürer (2007). Social acceptance of RE innovation: An introduction to the concept. Energy Policy 35(5):2683-2691.

Yi, H., and R.C. Feiock (2014). Renewable Energy Politics: Policy Typologies, Policy Tools, and State Deployment of Renewables. Policy Studies Journal 42(3): 391–415. https://doi.org/10.1111/psj.12066

Zoellner, J., P. Schweizer-Ries, and C. Wemheuer (2008). Public acceptance of RE: Results from case studies in Germany. Energy Policy 36(1): 4136-4141.

Acknowledgements

Funding: This work was supported by the Swiss National Science Foundation within the National Research Programme Managing Energy Consumption"(NRP 71); and was partially funded by the Eawag discretionary fund.

Appendix I

Table A.1: Variables, summary statistics, and operationalization

Variable			Operationalization
Dependent variables	Sample	Population	
Support of cantonal policy instruments: Information Subsidy Tax release Ban	1: 39.4% 0: 60.6% 1: 46.7% 0: 53.3% 1: 38.3% 0: 61.7% 1: 27.6% 0: 72.4%		Which instruments, laws, or rules do you think the canton should use to promote the construction of solar/wind/small-scale hydropower/geothermal power plants? Please tick all options you agree with: • Stronger information, guidance, and education for persons interested in the construction of RE plants. • Tax reliefs for operators of RE plants. • Subsidies for the construction of a new RE plant. • A ban on the construction of non-renewable electricity plants.
Explanatory variables			
Pro-sumer	Pro-sumer: 8.8% No pro-sumer: 91.2%		Dummy variable with a value of 1 if a respondent indicates that she/he invests in RE, for example, by producing RE or by having a stake in a RE site. All other respondents are assigned the value 0.
Climate change	Mean: 11.5 S.D.: Min.: 0 Max.: 16		Additive index based on four items (all items have been recoded so high values indicate that respondents think that anthropogenic climate change exists, whereas low values stand for climate scepticism): 1) I am not sure whether climate change is really happening. 2) Climate change is mainly anthropogenic. 3) The consequences of climate change are dramatized. 4) Climate change is an excuse to patronize citizens and raise taxes.
Nuclear phasing out	Mean: 3.9 S.D. Min.: 1 Max.: 5		In the Energy Strategy 2050, the Federal Council proposes nuclear phasing out. What do you think about this proposition? Four-point Likert scale: (5) Agree, (4) Rather agree, (3) Don't know, (2) Rather disagree, (1) Disagree
Male	Male: 47.7% Female: 52.3%	Male: 49.2% Female: 50.8%	Gender dummy: 1 = male (reference category), 0 = female.

Education	Low: 9.6%	Low: 12.10%	Three education categories: Lower Secondary (reference category), Higher Secondary, Tertiary.
	Medium: 47.7%	Medium: 46.34%	
	High: 42.7%	High: 41.55%	
Age	<31y.: 20.1%	<31y.: 17.75%	Four age categories: younger than 31 years (reference category), 31–45 years old, 46–65 years old, older than 65 years.
	31-45y.: 27.4%	31-45y.: 25.1%	
	46-65y.: 39.4%	46-65y: 34.82%	
	>65y.: 11.1%	>65y.: 22.33%	
Left-right placement	Don't know: 9.5%	Don't know: 9.21%	Four political self-placement categories: left, middle, right, no position (reference category).
	Left: 31.3%	Left: 23.62%	
	Middle: 47.0%	Middle: 33.76%	
	Right: 12.2%	Right: 33.42%	
Children in household	Has children: 31.2%		Dummy: 1 = with children, 0 = without children (reference category).
	No children: 68.8%		
Cantonal wind energy	Mean: 0.42		Indicator of cantonal instrument mix in wind energy (0–1). High values stand for a high density and inclusiveness, whereas low values mean an absence of a comprehensive instrument mix.
	S.D.:		
	Min.: 0		
	Max.: 1		
Cantonal solar power	Mean: 0.51		Indicator of cantonal instrument mix in solar energy (0–1). High values stand for a high density and inclusiveness, whereas low values mean an absence of a comprehensive instrument mix.
	S.D.:		
	Min.: 0		
	Max.: 1		
Cantonal water power	Mean: 0.64		Indicator of cantonal instrument mix in water energy (0–1). High values stand for a high density and inclusiveness, whereas low values mean an absence of a comprehensive instrument mix.
	S.D.:		
	Min: 0		
	Max: 1		
Instrument mix	1: 45.6%		Dummy variable taking the value of 1 if a comprehensive instrument mix exists in at least one energy area.
	0: 44.4%		